A

Practitioner's Docket No. 528-006231-US (C01) ***PATENT***

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Box Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

NEW APPLICATION TRANSMITTAL

Transmitted herewith for filing is the patent application of

Inventor(s): Samuel C. Kingston;
Thomas R. Giallorenzi; Randal R. Sylvester;
David Matolak; Patrick Smith

WARNING: *Patent must be applied for in the name(s) of all of the actual inventor(s). 37 CFR 1.41(a) and 1.53(b).*

For (title):

Multi-User Acquisition Procedure For
Point-To-Multipoint Synchronous CDMA Systems

CERTIFICATION UNDER 37 C.F.R. 1.10*
(Express Mail label number is mandatory.)
(Express Mail certification is optional.)

I hereby certify that this New Application Transmittal and the documents referred to as attached therein are being deposited with the United States Postal Service on this date 1/12/98, in an envelope as "Express Mail Post Office to Addressee," mailing Label Number EM174704384US, addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Jaime McElhill
(type or print name of person mailing paper)

Jaime McElhill
Signature of person mailing paper

WARNING: *Certificate of mailing (first class) or facsimile transmission procedures of 37 C.F.R. 1.8 cannot be used to obtain a date of mailing or transmission for this correspondence.*

***WARNING:** Each paper or fee filed by "Express Mail" **must** have the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 C.F.R. 1.10(b).*
*"Since the filing of correspondence under § 1.10 without the Express Mail mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will **not** be granted on petition." Notice of Oct. 24, 1996, 60 Fed. Reg. 56,439, at 56,442.*

1. Type of Application

This new application is for a(n)

(check one applicable item below)

☐ Original (nonprovisional)

☐ Design

☐ Plant

WARNING: ***Do not*** *use this transmittal for a completion in the U.S. of an International Application under 35 U.S.C. 371(c)(4), unless the International Application is being filed as a divisional, continuation or continuation-in-part application.*

WARNING: ***Do not*** *use this transmittal for the filing of a provisional application.*

NOTE: If one of the following 3 items apply, then complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF A PRIOR U.S. APPLICATION CLAIMED and a NOTIFICATION IN PARENT APPLICATION OF THE FILING OF THIS CONTINUATION APPLICATION.

☐ Divisional.

☒ Continuation.

☐ Continuation-in-part (C-I-P).

2. Benefit of Prior U.S. Application(s) (35 U.S.C. 119(e), 120, or 121)

NOTE: If the new application being transmitted is a divisional, continuation or a continuation-in-part of a parent case, or where the parent case is an International Application which designated the U.S., or benefit of a prior provisional application is claimed, then check the following item and complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

WARNING: *If an application claims the benefit of the filing date of an earlier filed application under 35 U.S.C. 120, 121 or 365(c), the 20-year term of that application will be based upon the filing date of the earliest U.S. application that the application makes reference to under 35 U.S.C. 120, 121 or 365(c). (35 U.S.C. 154(a)(2) does not take into account, for the determination of the patent term, any application on which priority is claimed under 35 U.S.C. 119, 365(a) or 365(b).) For a c-i-p application, applicant should review whether any claim in the patent that will issue is supported by an earlier application and, if not, the applicant should consider canceling the reference to the earlier filed application. The term of a patent is not based on a claim-by-claim approach. See Notice of April 14, 1995, 60 Fed. Reg. 20,195, at 20,205.*

WARNING: *When the last day of pendency of a provisional application falls on a Saturday, Sunday, or Federal holiday within the District of Columbia, any nonprovisional application claiming benefit of the provisional application* ***must*** *be filed prior to the Saturday, Sunday, or Federal holiday within the District of Columbia. See 37 C.F.R. § 1.78(a)(3).*

☒ The new application being transmitted claims the benefit of prior U.S. application(s). Enclosed are ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

3. Papers Enclosed That Are Required for Filing Date under 37 C.F.R. 1.53(b) (Regular) or 37 C.F.R. 1.153 (Design) Application

26 Pages of specification

5 Pages of claims

1 Pages of Abstract

6 Sheets of drawing

☐ formal

☐ informal

WARNING: ***DO NOT*** *submit original drawings. A high quality copy of the drawings should be supplied when filing a patent application. The drawings that are submitted to the Office must be on strong, white, smooth, and non-shiny paper and meet the standards according to § 1.84. If corrections to the drawings are necessary, they should be made to the original drawing and a high-quality copy of the corrected original drawing then submitted to the Office. Only one copy is required or desired. Comments on proposed new 37 CFR 1.84. Notice of March 9, 1988 (1990 O.G. 57-62).*

NOTE: "Identifying indicia, if provided, should include the application number or the title of the invention, inventor's name, docket number (if any), and the name and telephone number of a person to call if the Office is unable to match the drawings to the proper application. This information should be placed on the back of each sheet of drawing a minimum distance of 1.5 cm. (5/8 inch) down from the top of the page." 37 C.F.R. 1.84(c)).

(complete the following, if applicable)

☐ The enclosed drawing(s) are photograph(s), and there is also attached a "PETITION TO ACCEPT PHOTOGRAPH(S) AS DRAWING(S)." 37 C.F.R. 1.84(b).

4. Additional papers enclosed

☒ Preliminary Amendment

☒ Information Disclosure Statement (37 C.F.R. 1.98)

☒ Form PTO–1449 (PTO/SB/08A and 08B)

☒ Citations

☐ Declaration of Biological Deposit

☐ Submission of "Sequence Listing," computer readable copy and/or amendment pertaining thereto for biotechnology invention containing nucleotide and/or amino acid sequence.

☐ Authorization of Attorney(s) to Accept and Follow Instructions from Representative

☐ Special Comments

☐ Other

5. Declaration or oath

☒ Enclosed (copy)

Executed by

(check **all** *applicable boxes)*

☒ inventor(s).

☐ legal representative of inventor(s). 37 CFR 1.42 or 1.43.

☐ joint inventor or person showing a proprietary interest on behalf of inventor who refused to sign or cannot be reached.

☐ This is the petition required by 37 CFR 1.47 and the statement required by 37 CFR 1.47 is also attached. *See* item 13 below for fee.

☐ Not Enclosed.

WARNING: Where the filing is a completion in the U.S. of an International Application, but where a declaration is not available, or where the completion of the U.S. application contains subject matter in addition to the International Application, the application may be treated as a continuation or continuation-in-part, as the case may be, utilizing ADDED PAGE FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION CLAIMED.

☐ Application is made by a person authorized under 37 C.F.R. 1.41(c) on behalf of *all* the above named inventor(s).

(The declaration or oath, along with the surcharge required by 37 CFR 1.16(e) can be filed subsequently).

NOTE: It is important that all the correct inventor(s) are named for filing under 37 CFR 1.41(c) and 1.53(b).

☐ Showing that the filing is authorized.
(not required unless called into question. 37 CFR 1.41(d))

6. Inventorship Statement

WARNING: *If the named inventors are each not the inventors of all the claims an explanation, including the ownership of the various claims at the time the last claimed invention was made, should be submitted.*

The inventorship for all the claims in this application are:

☐ The same.

or

☐ Not the same. An explanation, including the ownership of the various claims at the time the last claimed invention was made,

☐ is submitted.

☐ will be submitted.

7. Language

NOTE: An application including a signed oath or declaration may be filed in a language other than English. A verified English translation of the non-English language application and the processing fee of $130.00 required by 37 CFR 1.17(k) is required to be filed with the application, or within such time as may be set by the Office. 37 CFR 1.52(d).

NOTE: A non-English oath or declaration in the form provided or approved by the PTO need not be translated. 37 CFR 1.69(b).

☒ English

☐ Non-English

☐ The attached translation is a verified translation. 37 C.F.R. 1.52(d).

8. Assignment

☒ An assignment of the invention to L-3 Communications Corporation was recorded on 10/10/97 Reel 8749/Frame 0370

☐ is attached. A separate ☐ "COVER SHEET FOR ASSIGNMENT (DOCUMENT) ACCOMPANYING NEW PATENT APPLICATION" or ☐ FORM PTO 1595 is also attached.

☐ will follow.

NOTE: "If an assignment is submitted with a new application, send two separate letters-one for the application and one for the assignment." Notice of May 4, 1990 (1114 O.G. 77-78).

WARNING: *A newly executed "CERTIFICATE UNDER 37 CFR 3.73(b)" must be filed when a continuation-in-part application is filed by an assignee. Notice of April 30, 1993, 1150 O.G. 62-64.*

9. Certified Copy

Certified copy(ies) of application(s)

Country	Appln. No.	Filed
Country	Appln. No.	Filed
Country	Appln. No.	Filed

from which priority is claimed

☐ is (are) attached.

☐ will follow.

NOTE: The foreign application forming the basis for the claim for priority must be referred to in the oath or declaration. 37 CFR 1.55(a) and 1.63.

NOTE: This item is for any foreign priority for which the application being filed directly relates. If any parent U.S. application or International Application from which this application claims benefit under 35 U.S.C. 120 is itself entitled to priority from a prior foreign application, then complete item 18 on the ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

10. Fee Calculation (37 C.F.R. 1.16)

A. ☒ Regular application

CLAIMS AS FILED				
Number filed	Number Extra		Rate	Basic Fee 37 C.F.R. 1.16(a) $790.00
Total Claims (37 CFR 1.16(c)) 5– 20 =	0	×	$ 22.00	
Independent Claims (37 CFR 1.16(b)) 2– 3 =	0	×	$ 82.00	
Multiple dependent claim(s), if any (37 CFR 1.16(d))		+	$270.00	

☒ Amendment cancelling extra claims is enclosed.

☐ Amendment deleting multiple-dependencies is enclosed.

☐ Fee for extra claims is not being paid at this time.

NOTE: If the fees for extra claims are not paid on filing they must be paid or the claims cancelled by amendment, prior to the expiration of the time period set for response by the Patent and Trademark Office in any notice of fee deficiency. 37 CFR 1.16(d).

Filing Fee Calculation $790.00

B. ☐ Design application
($330.00—37 CFR 1.16(f))

Filing Fee Calculation $_____

C. ☐ Plant application
($540.00—37 CFR 1.16(g))

Filing fee calculation $_____

11. Small Entity Statement(s)

☐ Verified Statement(s) that this is a filing by a small entity under 37 CFR 1.9 and 1.27 is (are) attached.

WARNING: "Status as a small entity in one application or patent does not affect any other application or patent, including applications or patents which are directly or indirectly dependent upon the application or patent in which the status has been established. A nonprovisional application claiming benefit under 35 U.S.C. 119(e), 120, 121 or 365(c) of a prior application may rely on a verified statement filed in the prior application if the nonprovisional application includes a reference to a verified statement in the prior application or includes a copy of the verified statement filed in the prior application if status as a small entity is still proper and desired." 37 C.F.R. § 1.28(a).

(complete the following, if applicable)

☐ Status as a small entity was claimed in prior application

_____ / _____, filed on _____, from which benefit is being claimed for this application under:

35 U.S.C. ☐ 119(e),
☐ 120,
☐ 121,
☐ 365(c),

and which status as a small entity is still proper and desired.

☐ A copy of the verified statement in the prior application is included.

Filing Fee Calculation (50% of **A**, **B** or **C** above)

$_____

NOTE: Any excess of the full fee paid will be refunded if a verified statement and a refund request are filed within 2 months of the date of timely payment of a full fee. The two-month period is not extendable under § 1.136. 37 CFR 1.28(a).

12. Request for International-Type Search (37 C.F.R. 1.104(d))

(complete, if applicable)

☐ Please prepare an international-type search report for this application at the time when national examination on the merits takes place.

13. Fee Payment Being Made at This Time

☐ Not Enclosed

☐ No filing fee is to be paid at this time.
(This and the surcharge required by 37 C.F.R. 1.16(e) can be paid subsequently.)

☒ Enclosed

☒ Filing fee $ 790.00

☐ Recording assignment
($40.00; 37 C.F.R. 1.21(h))
(See attached "COVER SHEET FOR ASSIGNMENT ACCOMPANYING NEW APPLICATION".) $ _____

☐ Petition fee for filing by other than all the inventors or person on behalf of the inventor where inventor refused to sign or cannot be reached
($130.00; 37 C.F.R. 1.47 and 1.17(h)) $ _____

☐ For processing an application with a specification in
a non-English language
($130.00; 37 C.F.R. 1.52(d) and 1.17(k)) $ _____

☐ Processing and retention fee
($130.00; 37 C.F.R. 1.53(d) and 1.21(l)) $ _____

☐ Fee for international-type search report
($40.00; 37 C.F.R. 1.21(e)) $ _____

NOTE: 37 CFR 1.21(l) establishes a fee for processing and retaining any application that is abandoned for failing to complete the application pursuant to 37 CFR 1.53(d) and this, as well as the changes to 37 CFR 1.53 and 1.78, indicate that in order to obtain the benefit of a prior U.S. application, either the basic filing fee must be paid, or the processing and retention fee of § 1.21(l) must be paid, within 1 year from notification under § 53(d).

Total fees enclosed $ 790.00

14. Method of Payment of Fees

☒ Check in the amount of $ 790.00

☐ Charge Account No. _____ in the amount of $_____.
A duplicate of this transmittal is attached.

NOTE: Fees should be itemized in such a manner that it is clear for which purpose the fees are paid. 37 CFR 1.22(b).

15. Authorization to Charge Additional Fees

WARNING: If no fees are to be paid on filing, the following items should not be completed.

WARNING: Accurately count claims, especially multiple dependent claims, to avoid unexpected high charges, if extra claim charges are authorized.

☒ The Commissioner is hereby authorized to charge the following additional fees by this paper and during the entire pendency of this application to Account No. 16-1350 :

☒ 37 C.F.R. 1.16(a), (f) or (g) (filing fees)

☒ 37 C.F.R. 1.16(b), (c) and (d) (presentation of extra claims)

NOTE: Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid or these claims cancelled by amendment prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 CFR 1.16(d)), it might be best not to authorize the PTO to charge additional claim fees, except possibly when dealing with amendments after final action.

☒ 37 C.F.R. 1.16(e) (surcharge for filing the basic filing fee and/or declaration on a date later than the filing date of the application)

☒ 37 C.F.R. 1.17 (application processing fees)

WARNING: While 37 CFR 1.17(a), (b), (c) and (d) deal with extensions of time under § 1.136(a), this authorization should be made only with the knowledge that: "Submission of the appropriate extension fee under 37 C.F.R. 1.136(a) is to no avail unless a request or petition for extension is filed." (Emphasis added). Notice of November 5, 1985 (1060 O.G. 27).

☐ 37 C.F.R. 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 C.F.R. 1.311(b))

NOTE: Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of allowance. 37 CFR 1.311(b).

NOTE: 37 CFR 1.28(b) requires "Notification of any change in status resulting in loss of entitlement to small entity status must be filed in the application . . . prior to paying, or at the time of paying, . . . issue fee." From the wording of 37 CFR 1.28(b), (a) notification of change of status must be made even if the fee is paid as "other than a small entity" and (b) no notification is required if the change is to another small entity.

16. Instructions as to Overpayment

☒ Credit Account No. 16-1350

☐ Refund

SIGNATURE OF PRACTITIONER

Reg. No. 32,493

Harry F. Smith

(type or print name of attorney)

Tel. No. ( )
(203) 259-1800

Perman & Green, LLP

P.O. Address 425 Post Road
Fairfield, CT 06430

Customer No.

☒ **Incorporation by reference of added pages**

(check the following item if the application in this transmittal claims the benefit of prior U.S. application(s) (including an international application entering the U.S. stage as a continuation, divisional or C-I-P application) and complete and attach the ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED)

☒ Plus Added Pages for New Application Transmittal Where Benefit of Prior U.S. Application(s) Claimed

Number of pages added _____

☐ Plus Added Pages for Papers Referred to in Item 4 Above

Number of pages added _____

☐ Plus "Assignment Cover Letter Accompanying New Application"

Number of pages added _____

☐ **Statement Where No Further Pages Added**

(if no further pages form a part of this Transmittal, then end this Transmittal with this page and check the following item)

☐ This transmittal ends with this page.

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Practitioner's Docket No. _____ ***PATENT***

ADDED-PAGES FOR APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED

NOTE: See 37 CFR 1.78(a).

17. Relate Back

WARNING: If an application claims the benefit of the filing date of an earlier filed application under 35 U.S.C. 120, 121 or 365(c), the 20–year term of that application will be based upon the filing date of the earliest U.S. application that the application makes reference to under 35 U.S.C. 120, 121 or 365(c). (35 U.S.C. 154(a)(2) does not take into account, for the determination of the patent term, any application on which priority is claimed under 35 U.S.C. 119, 365(a) or 365(b).) For a c–i–p application, applicant should review whether any claim in the patent that will issue is supported by an earlier application and, if not, the applicant should consider canceling the reference to the earlier filed application. The term of a patent is not based on a claim-by-claim approach. See Notice of April 14, 1995, 60 Fed. Reg. 20,195, at 20,205.

(complete the following, if applicable)

☒ Amend the specification by inserting, before the first line, the following sentence:

A. 35 U.S.C. 119(e)

NOTE: "Any nonprovisional application claiming the benefit of one or more prior filed copending provisional applications must contain or be amended to contain in the first sentence of the specification following the title a reference to each such prior provisional application, identifying it as a provisional application, and including the provisional application number (consisting of series code and serial number)." 37 C.F.R. § 1.78(a)(4).

☐ "This application claims the benefit of U.S. Provisional Application(s) No(s).:

APPLICATION NO(S).:	FILING DATE
_____ /_____	_____ "
_____ /_____	_____ "
_____ /_____	_____ "

B. 35 U.S.C. 120, 121 and 365(c)

NOTE: "Any nonprovisional application claiming the benefit of one or more prior filed copending nonprovisional applications or international applications designating the United States of America must contain or be amended to contain in the first sentence of the specification following the title a reference to each such prior application, identifying it by application number (consisting of the series code and serial number) or international application number and international filing date and indicating the relationship of the applications. Cross-references to other related applications may be made when appropriate." (See § 1.14(b)). 37 C.F.R. § 1.78(a)(2).

☒ "This application is a

- ☒ continuation
- ☐ continuation-in-part
- ☐ divisional

of copending application(s)

☒ application number 0 8/ 606,378 filed on 2/23/96 "

☐ International Application _____ filed on

_____ and which designated the U.S."

NOTE: The proper reference to a prior filed PCT application that entered the U.S. national phase is the U.S. serial number and the filing date of the PCT application that designated the U.S.

NOTE: (1) Where the application being transmitted adds subject matter to the International Application, then the filing can be as a continuation-in-part or (2) if it is desired to do so for other reasons then the filing can be as a continuation.

☐ "The nonprovisional application designated above, namely application _____ / _____, filed _____, claims the benefit of U.S. Provisional Application(s) No(s).:

APPLICATION NO(S).:	FILING DATE
_____ / _____	_____ "
_____ / _____	_____ "
_____ / _____	_____ "

NOTE: The deadline for entering the national phase in the U.S. for an international application was clarified in the Notice of April 28, 1987 (1079 O.G. 32 to 46) as follows:

"The Patent and Trademark Office considers the international application to be pending until the 22nd month from the priority date if the United States has been designated and no Demand for International Preliminary Examination has been filed prior to the expiration of the 19th month from the priority date and until the 32nd month from the priority date if a Demand for International Preliminary Examination which elected the United States of America has been filed prior to the expiration of the 19th month from the priority date, provided that a copy of the international application has been communicated to the Patent and Trademark Office within the 20 or 30 month period respectively. If a copy of the international application has not been communicated to the Patent and Trademark Office within the 20 or 30 month period respectively, the international application becomes abandoned as to the United States 20 or 30 months from the priority date respectivley. These periods have been placed in the rules as paragraph (h) of § 1.494 and paragraph (i) of § 1.495. A continuing application under 35 U.S.C. 365(c) and 120 may be filed anytime during the pendency of the international application."

18. Relate Back—35 U.S.C. 119 Priority Claim for Prior Application

The prior U.S. application(s), including any prior International Application designating the U.S., identified above in item 17B, in turn itself claim(s) foreign priority(ies) as follows:

Country	Appln. no.	Filed on

The certified copy(ies) has (have)

☐ been filed on _____, in prior application 0 /_____, which was filed on _____.

☐ is (are) attached.

*WARNING: The certified copy of the priority application that may have been communicated to the PTO by the International Bureau may **not** be relied on without any need to file a certified copy of the priority application **in the continuing application.** This is so because the certified copy of the priority application communicated by the International Bureau is placed in a folder and is not assigned a U.S. serial number unless the national stage is entered. Such folders are disposed of if the national stage is not entered. Therefore, such certified copies may not be available if needed later in the prosecution of a continuing application. An alternative would be to physically remove the priority documents from the folders and transfer them to the continuing application. The resources required to request transfer, retrieve the folders, make suitable record notations, transfer the certified copies, enter and make a record of such copies in the Continuing Application are substantial. Accordingly, the priority documents in folders of international applications that have not entered the national stage may not be relied on. Notice of April 28, 1987 (1079 O.G. 32 to 46).*

19. Maintenance of Copendency of Prior Application

NOTE: The PTO finds it useful if a copy of the petition filed in the prior application extending the term for response is filed with the papers constituting the filing of the continuation application. Notice of November 5, 1985 (1060 O.G. 27).

A. ☐ Extension of time in prior application

*(This item **must** be completed and the papers filed **in the prior application,** if the period set in the prior application has run.)*

☐ A petition, fee and response extends the term in the pending **prior** application until _____.

☐ A **copy** of the petition filed in prior application is attached.

B. ☐ Conditional Petition for Extension of Time in Prior Application

(complete this item, if previous item not applicable)

☐ A conditional petition for extension of time is being filed in the pending **prior** application.

☐ A **copy** of the conditional petition filed in the prior application is attached.

20. Further Inventorship Statement Where Benefit of Prior Application(s) Claimed

*NOTE: "If the continuation, continuation-in-part, or divisional application is filed by less than all the inventors named in the prior application a statement **must** accompany the application when filed requesting deletion of the names of the person or persons who are not inventors of the invention being claimed in the continuation, continuation-in-part, or divisional application." 37 CFR 1.62(a) [emphasis added] (dealing with the file wrapper continuation situation).*

NOTE: "In the case of a continuation-in-part application which adds and claims additional disclosure by amendment, an oath or declaration as required by § 1.63 must be filed. In those situations where a new oath or declaration is required due to additional subject matter being claimed, additional inventors may be named in the continuing application. In a continuation or divisional application which discloses and claims only subject matter disclosed in a prior application, no additional oath or declaration is required and the application must name as inventors the same or less than all the inventors in the prior application." 37 CFR 1.62(c) (dealing with the continuation situation).

(complete applicable item (a), (b) and/or (c) below)

(a) ☒ This application discloses and claims only subject matter disclosed in the prior application whose particulars are set out above and the inventor(s) in this application are

- ☒ the same.
- ☐ less than those named in the prior application. It is requested that the following inventor(s) identified for the prior application be deleted:

_____

(type name(s) of inventor(s) to be deleted)

(b) ☐ This application discloses and claims additional disclosure by amendment and a new declaration or oath is being filed. With respect to the prior application, the inventor(s) in this application are

- ☐ the same.
- ☐ the following additional inventor(s) have been added:

_____

(type name(s) of inventor(s) to be added)

(c) The inventorship for all the claims in this application are

- ☐ the same.
- ☐ not the same. An explanation, including the ownership of the various claims at the time the last claimed invention was made
  - ☐ is submitted.
  - ☐ will be submitted.

21. Abandonment of Prior Application *(if applicable)*

☐ Please abandon the prior application at a time while the prior application is pending, or when the petition for extension of time or to revive in that application is granted, and when this application is granted a filing date, so as to make this application copending with said prior application.

NOTE: According to the Notice of May 13, 1983 (103, TMOG 6-7), the filing of a continuation or continuation-in-part application is a proper response with respect to a petition for extension of time or a petition to revive and should include the express abandonment of the prior application conditioned upon the granting of the petition and the granting of a filing date to the continuing application.

22. Petition for Suspension of Prosecution for the Time Necessary to File an Amendment

WARNING: "The claims of a new application may be finally rejected in the first Office action in those situations where (1) the new application is a continuing application of, or a substitute for, an earlier application, and (2) all the claims of the new application (a) are drawn to the same invention claimed in the earlier application, and (b) would have been properly finally rejected on the grounds of art of record in the next Office action if they had been entered in the earlier application." MPEP, § 706.07(b).

NOTE: Where it is possible that the claims on file will give rise to a first action final for this continuation application and for some reason an amendment cannot be filed promptly (e.g., experimental data is being gathered) it may be desirable to file a petition for suspension of prosecution for the time necessary.

(check the next item, if applicable)

☐ There is provided herewith a Petition To Suspend Prosecution for the Time Necessary to File An Amendment (New Application Filed Concurrently)

23. Small Entity (37 CFR § 1.28(a))

☐ Applicant has established small entity status by the filing of a verified statement in parent application /_____ on _____ .

☐ A copy of the verified statement previously filed is included.

WARNING: See 37 CFR § 1.28(a).

24. NOTIFICATION IN PARENT APPLICATION OF THIS FILING

☐ A notification of the filing of this
(check one of the following)

☐ continuation

☐ continuation-in-part

☐ divisional

is being filed in the parent application, from which this application claims priority under 35 U.S.C. § 120.

EXPRESS MAIL NO.: EM 174 704 384 US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:

INVENTORS: S. Kingston et al.
TITLE: MULTI-USER ACQUISITION PROCEDURE FOR POINT-TO -MULTIPOINT SYNCHRONOUS CDMA SYSTEMS
SERIAL NO.: 08/ EXAMINER: Bnimoussa, A.
FILED: Herewith ART UNIT: 2603
ATTORNEY'S DOCKET NO.: 528-006231-US(C01)

Hon. Commissioner of Patents and Trademarks
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Sir:

This preliminary amendment is herewith submitted in conjunction with a continuation application filed under 37 C.F.R. §1.53(b). The parent application is allowed U.S. Patent Application S.N. 08/606,378, filed 2/23/96.

Please amend the Application as set forth below.

In the Specification:

At page 1, line 16, insert --606,285-- after "08/".

At page 1, line 17, insert the date --February 23, 1996-- before ", entitled".

In the Claims:

Cancel claims 2-15 without prejudice or disclaimer, thereby leaving originally filed claim 1 pending for filing purposes.

Please add the following new claims.

-- 16. A method for operating a synchronous CDMA communications system, comprising steps of:

providing a plurality of subscriber units (SUs);

providing at least one radio base unit (RBU) for transmitting a signal comprised of a plurality of first forward channels individual ones of which being intended for receipt by one subscriber unit (SU), and for transmitting at least one second forward channel that is intended for receipt by a plurality of SUs, each of said forward channels being spread with an associated spreading code that has, ideally, an orthogonal relationship to spreading codes of the other forward channels;

receiving the transmitted signal at a SU;

despreading the received signal using a spreading code associated with the second forward channel to obtain a first measure of received signal energy;

despreading the received signal using a null spreading code that is known not to be transmitted by the RBU to obtain a second measure of received signal energy, the null spreading code having, ideally, an orthogonal relationship to the spreading codes of the forward channels; and

in the SU, adjusting a phase of the spreading code associated with the second forward channel based on the first and second measures of received signal energy.

17. A method as in claim 16, wherein the step of

obtaining a first measure of received signal energy obtains a correlation peak, and wherein the step of obtaining a second measure of received signal energy obtains a correlation null.

18. A method as in claim 16, wherein the steps of despreading and obtaining are performed over a range of phase states.

19. A method as in claim 18, and further comprising steps of:

subtracting the results obtained for each phase state;

comparing a difference value to a threshold value; and

terminating the steps of despreading and obtaining when the difference value exceeds the threshold value, and storing the corresponding phase state; else

if the difference value does not exceed the threshold value after performing the steps of despreading and obtaining over the range of phase states, storing the phase state corresponding to a largest difference value; wherein

the stored phase state is used in the step of adjusting.--

<u>REMARKS</u>

The specification has been amended to insert the serial number and filing date of the related application referred to at page 1.

Claim 1 has been retained for filing purposes, claims 2-15 have been cancelled, and claims 16-19 have been newly

added.

Appended to this response is an IDS that makes of record the prior art from the parent application. In addition, U.S. Patent No.: 5,574,721 has been cited. The undersigned recently became aware of this patent, which teaches the use of a "phantom carrier signal" in an orthogonal CDMA system.

All of the claims of this continuation patent application are deemed to be allowable over the prior art of record. A favorable consideration that results in the allowance of the claims is earnestly solicited.

Respectfully submitted,

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A MULTI-USER ACQUISITION PROCEDURE FOR POINT-TO-MULTIPOINT SYNCHRONOUS CDMA SYSTEMS

CROSS-REFERENCE TO A RELATED PATENT APPLICATION:

This patent application is related to commonly assigned U.S. Patent Application Serial Number 08/_____, filed _____, entitled "A MULTI-USER ACQUISITION PROCEDURE FOR MULTIPOINT-TO-POINT SYNCHRONOUS CDMA SYSTEMS", by S. Kingston et al. (Attorney Docket No. DUT 513).

FIELD OF THE INVENTION:

This invention pertains generally to code division, multiple access (CDMA) communication systems and, in particular, to direct-sequence (DS) point-to-multipoint synchronous CDMA communications systems.

BACKGROUND OF THE INVENTION:

In a CDMA communications system a plurality of user communication signals can be transmitted within, i.e., share, a same portion of the frequency spectrum. This is accomplished by providing a plurality of different pseudonoise (pn) binary code sequences (e.g., one for each user) that modulate a carrier, thereby "spreading" the spectrum of the resulting waveform. In a given receiver all of the user signals are received, and one is selected by applying an assigned one of the pn binary code sequences to a correlator to extract only the signal energy intended for

the receiver, thereby "despreading" the received CDMA transmission. All other (uncorrelated) user transmissions appear as noise.

One type of CDMA communication system is specified by a document referred to as EIA/TIA/IS-95. The system as specified uses a plurality of base stations that establish and maintain bidirectional direct-sequence (DS) CDMA links with a plurality of mobile stations (e.g., cellular telephones). One feature of the IS-95 system is the presence of a pilot channel that is transmitted by each base station.

The pilot channel is an unmodulated, direct-sequence spread spectrum signal that is transmitted continuously by each CDMA base station. The pilot channel allows a mobile station to acquire the timing of the Forward CDMA channel (i.e., from the base station to the mobile station), provides a phase reference for coherent demodulation, and provides a reference for signal strength comparisons between base stations for determining when to handoff. The pilot pn sequence is defined as a pair of modified maximal length PN sequences with period 2^{15} that are used to spread the Forward CDMA channel and the Reverse CDMA channel. Different base stations are identified by different pilot PN sequence offsets. A pilot pn sequence offset index is defined to be in units of 64 pn chips, relative to a zero offset pilot pn sequence. A pn chip is defined as one bit in the pn sequence. The pilot strength is defined as the ratio of received pilot energy to overall received energy.

Walsh functions are a class of 2^N time orthogonal binary functions that are used to establish orthogonality between the different pn binary code sequences used by the pilot and user channels.

The use of the pilot channels, while providing certain

advantages in a CDMA system intended for use with mobile stations, may present disadvantages as well, particularly in systems where the user transceivers are fixed as opposed to mobile. For example, the pilot channels consume some amount of the available pn code sequences and signal energy, all of which could be otherwise allocated to the users of the system.

Also, in many detection approaches synchronization to the pn code timing must be achieved before carrier phase-lock can occur. In this case a non-coherent detection algorithm must be employed. Generally, non-coherent detectors rely on energy detection within a fixed bandwidth, as a range of code timing cells are searched. Upon locating the correct code timing, the detector energy level rises above a predetermined threshold level. A bit-sync loop then takes over to obtain the finer-resolution bit timing.

However, standard acquisition approaches are known to fail when the number of users becomes large. This is due to the fact that the noise power becomes comparable to the signal power when the user of a synchronous type of CDMA system is not synchronized. As a result, it becomes very difficult for the user's receiver to distinguish the correct pn timing phase from the incorrect phases resulting from the increased noise.

As can be appreciated, the acquisition technique is an important aspect of the receiver, in that its operation impacts the overall speed at which synchronization to the forward link occurs. If the time required to synchronize the user's receiver becomes excessive, the delay may be considered as objectional by the user.

OBJECTS OF THE INVENTION:

It is a first object of this invention to provide methods and apparatus to enable a receiver to synchronize to a synchronous CDMA communications system.

It is a further object of this invention to provide methods and apparatus for implementing a synchronous CDMA system wherein a first forward channel transmits a null (inactive) pn code sequence that is orthogonal to all active codes, a second forward channel transmits an always-active pn code sequence, and wherein a receiver uses either the first forward channel, the second forward channel, or both of the forward channels to synchronize to the forward CDMA link.

SUMMARY OF THE INVENTION

The foregoing and other problems are overcome and the objects of the invention are realized by methods and apparatus in accordance with embodiments of this invention, wherein a user terminal is provided with circuitry and methods enabling the acquisition of a desired CDMA channel in the presence of a plurality of synchronous interfering channels.

In one aspect, this invention teaches a method for synchronizing to a forward channel in a CDMA system. The method includes steps of (a) despreading a received CDMA signal with a first pn code that is known not to be present in the received CDMA signal, (b) obtaining a measure of received signal level, and (c) using the obtained measure of the received signal level when setting a phase of a second pn code that corresponds to a desired forward channel that is to be received. In this method the step of despreading despreads a null channel, and the desired forward channel is a continuously transmitted side-channel that provides system-level information to all subscriber

units or terminals.

In another aspect this invention teaches a method for acquiring a forward channel in a point-to-multipoint CDMA system. This method includes the steps of (a) despreading a received CDMA signal with a first pn code that is known to be present in the received CDMA signal and obtaining a first measure of received signal level; (b) despreading the received CDMA signal with a second pn code that is known not to be present in the received CDMA signal and obtaining a second measure of received signal level; and (c) synchronizing to a desired channel using a difference between the first and second signal levels.

In this method the first step of despreading despreads a continuously transmitted side-channel, and the step of synchronizing synchronizes to the side-channel. Also, the step of obtaining a first measure of received signal level obtains a correlation peak, and the step of obtaining a second measure of received signal level obtains a correlation null.

Preferably, the steps of despreading and obtaining are accomplished iteratively over a range of n first pn code phase states and over a range of n second pn code phase states. For a pn code phase state i of the plurality n of first and second pn code states, the method further determines a difference value between the first measure of received signal level and the second measure of received signal level; compares the difference value to a threshold value; and, if the difference value is greater than the threshold value, sets a pn code generator to output a pn code corresponding to the desired channel, wherein the outputted pn code is set at the pn phase state i. Else, if the difference value is not greater than the threshold value, the method instead increments the pn phase state i and re-executes the steps of despreading and obtaining.

In this method the step of determining the difference value includes a step of storing the determined difference value, and if none of the n difference values are greater than the threshold value, the method further includes a step of examining the stored difference values to select a stored difference value that has a largest value; and a step of setting the pn code generator to output the pn code corresponding to the desired channel, wherein the outputted pn code is set to a pn phase state that corresponds to the selected stored difference value.

In a further aspect, this invention teaches a synchronous CDMA communication system that operates in accordance with the foregoing methods.

BRIEF DESCRIPTION OF THE DRAWINGS

The above set forth and other features of the invention are made more apparent in the ensuing Detailed Description of the Invention when read in conjunction with the attached Drawings, wherein:

Fig. 1 is a simplified block diagram of a synchronous, DS-CDMA communications system that is constructed and operated in accordance with this invention, the system having a radio base unit (RBU) and a plurality of subscriber units (SUs).

Fig. 2 is a block diagram of a first embodiment of the SU receiver detector of Fig. 1, in particular a non-coherent square law detector.

Fig. 3 is a block diagram of a second embodiment of the SU receiver detector of Fig. 1, in particular a non-coherent absolute value detector.

Fig. 4 is a graph that illustrates the relative mean

acquisition time performance of the single-user, multi-user, and difference tests of this invention, for the case E_s/N_o = 6 dB, P_d = 0.995, and α - .01, and for a range of numbers of active users.

Fig. 5 is a graph that illustrates an average multi-user interference power and average side-channel correlation power versus code timing offset, with 3 pole Butterworth transmitter and receiver filters, and 30 active users.

Fig. 6 is a graph that illustrates energy versus offset for a desired subscriber unit, for multi-user interference, and for background noise.

Figs. 7A-7D are graphs that illustrate energy versus offset curves for the outputs of matched filters that are matched to the side-channel PN code (dashed line) and a null-code (solid line) for the cases of high and low SNR, as well as heavy and light loading. In these Figures the symbol X = matched filter output for the side-channel code, and the symbol □ = matched filter output for the null-code.

Fig. 8 is a logic flow diagram of a channel acquisition method in accordance with this invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Fig. 1, a synchronous CDMA communications system 10, which in presently preferred embodiments of this invention is embodied as a fixed wireless system (FWL), is considered herein to be a CDMA system wherein forward link (FL) transmissions from a radio base unit (RBU) 12 for a plurality of user or subscriber units (SUs) 14 are bit and chip aligned in time, and wherein the SUs 14 operate in accordance with the teaching of this invention for receiving the FL transmissions and for synchronizing to one of the transmissions. The FWL is suitable for use in

implementing a telecommunications system that conveys voice and/or data between the RBU 12 and the SUs 14.

The RBU 12 includes circuitry for generating a plurality of user signals (USER_1 to USER_n), a side channel (SIDE_CHAN) signal that is continuously transmitted, and a NULL signal. Each of these signals is assigned a respective pn spreading code and is modulated therewith before being applied to a transmitter 12a having an antenna 12b. When transmitted on the FL the transmissions are modulated in phase quadrature, and the SUs 14 are assumed to include suitable phase demodulators for deriving in-phase (I) and quadrature (Q) components therefrom. The illustrated arrangement is for one frequency (carrier) channel, it being realized that the RBU 12 is capable of transmitting a plurality of such frequency channels. By example, each frequency channel includes up to 31 code channels, and has a center frequency in the range of 2 GHz to 3 GHz.

Each SU 14 includes an antenna 14a, a mixer 14b for down-converting the received signal, a correlator 14c wherein the user's transmission is obtained by despreading the received signal with a local pn code, and a detector and correlator 14d. Suitable embodiments for the detector are a non-coherent square law detector shown in Fig. 2 and also a non-coherent absolute value detector shown in Fig. 3. The SU 14 also includes a local processor 14e that is responsible for managing the operation of the SU 14. These management functions include generating a variable local oscillator (LO) signal, such as is obtained from a voltage controlled oscillator (VCO) 14f, and providing the pn binary code sequence that is assigned to the SU 14 for despreading the user's signal. The processor 14e is also responsible for executing one or more of the acquisition methods in accordance with this invention. Although the SU 14 is capable of also transmitting a DS-CDMA signal to the RBU 12 on a return link, these functions are not germane to

the teaching of this invention and are thus not illustrated.

For the presently preferred embodiments of this invention the antennas 12b and 14a have a line-of-sight relationship, the SUs 14 are fixed in location with respect to the RBU 12, and the antennas 12b and 14a are boresighted during installation of the SU 14. However, and as will be discussed below, the teachings of this invention are not limited to only this particular presently preferred arrangement.

The ensuing description assumes the use of a DS signal, $a(t)$, with code symbol duration T_s, multiplied by a spreading sequence $c(t)$, with chip duration T_c and a null-to-null bandwidth $W_c = 2/T_c$. The symbol rate for each SU 14 is fixed at $1/T_s$, and the chipping rate at $1/T_c = P/T_s$. All of the pn codes are mutually orthogonal when aligned, and are assumed to be accurately aligned during normal operation. In the presently preferred embodiments of this invention the pn codes are selected from a set of randomized Walsh-Hadamard codes. The teaching of this invention is not, however, limited to only signals having these characteristics. By example, the set of pn spreading codes can be selected from any set that exhibits low cross-correlation at zero relative shift.

In the absence of multi-user interference, the received signal can be written as $r(t) = a(t-r)c(t-r) + n(t)$, where $n(t)$ represents white gaussian channel noise. $r(t)$ is multiplied by successive shifts of the spreading sequence, $c(t - m\delta t)$, in an attempt to estimate the timing offset, r. The detector filter 17 of Figs. 2 and 3 is a finite (T_s) integrator with an equivalent noise bandwidth $W_s = 1/T_s$. Within this bandwidth, the effective noise power spectral density, $\frac{1}{2}N_o$, is unchanged by the integrator. When $c(t-m\delta t)$ is synchronous with $r(t)$; the pn spreading code is

collapsed, and the integrator produces mean values of the DS signal, a(t-r). Assuming non-synchronous operation, most of the signal energy falls outside the bandwidth of the detector filter 17 and, to a good approximation, the detector input can be taken as white gaussian noise only. For worst case non-synchronous operation, the signal energy is reflected back into the spread bandwidth, W_c.

The sum of n samples of a squared gaussian process is central χ^2 distributed with n degrees of freedom, and has a bandwidth (near DC) twice that of the detector filter 17. The central χ^2 distribution with n degrees of freedom can be written

$$Py(y) = \frac{1}{\sigma^n \, 2^{n/2} \Gamma(n/2)} y^{n/2-1} e^{-y/2\sigma^2}, \quad y \geq 0,$$

where σ is the variance of the gaussian process.

Given spread code synchronization (i.e., $m\delta t \approx r$), the spectrum of the received signal is collapsed to the data bandwidth, thus increasing the total energy within the detector filter 17. Because the phase of the received signal rotates freely with respect to the reference, this waveform is not DC, even for a constant energy signal. It would thus appear that the output of the detector should again be central χ^2 distributed, but with a larger mean value than for the noise only case. However, the phase rotation rate is assumed to be slow enough that the signal component can be treated as deterministic, and hence the ith independent sample of the detector filter output is distributed normally with mean s_i and variance σ^2 determined by the noise component. The integrator output is then characterized by a non-central χ^2 distribution with n degrees of freedom, and a non-centrality parameter:

$$\lambda = \sum_{i=1}^{N} s_i^2 = nS,$$

where S represents the average signal power. The non-central χ^2 distribution with n degrees of freedom can be written as:

$$Py(y) = \frac{1}{2\sigma^2} \left(\frac{y}{\lambda}\right)^{(n-2)/4} e^{-(\lambda+y)/2\sigma^2} I_{n/2-1}\left(\frac{\sqrt{y\lambda}}{\sigma^2}\right), \quad y \geq 0.$$

Finally, a summation of n samples from block 21 is compared in block 23 to a preset threshold, t_h. The threshold and the number of samples are set to achieve a probability of detection $\geq P_d$ simultaneously with a probability of false alarm $\leq \alpha$. Give t_h, P_d can be determined by integrating the non-central χ^2 distribution from t_h to ∞. The probability of false alarm, α, is determined by integrating the central χ^2 distribution from t_h to ∞. As the integration time, T, becomes larger, the spread between the two distributions also becomes larger. At some point, the required detection probability can be achieved while simultaneously achieving the target false alarm probability. The minimum number of samples required to achieve the target detection and false alarm probability criteria determines the observation window of the detector, $T=nT_s$.

However, normally some time uncertainty will exist, and some number (Q) of time cells must be searched. The mean acquisition time is then determined as follows: Given a H_o case (a noise only case), the time required to search a single time cell is given by the expression

$$T_o = T + \alpha KT,$$

where K is referred to as the cost for a false alarm. If it is assumed that, upon exceeding the threshold, a verification procedure is begun, and that this verification procedure includes a second integration of length KT, which is long enough to assure that the probability of a second false alarm is negligible, then $T_o = (1 + \alpha K)T$. On average, $(\frac{1}{2}Q-1)$ time cells must be searched before encountering the correct cell. Next, the time required to

search a time cell given by a H_1 case (a signal present case), is given by the expression

$$T_1 = P_d(1 + K)T + (1 - P_d)(\tfrac{1}{2}QT_o + T_{acq}).$$

The first term corresponds to a successful detection, in which case a verification procedure is also required. The second term corresponds to a detection failure (in which case the acquisition procedure must be started from the beginning, but increased by $\frac{1}{2}QT_o$ (since all time cells must now be searched). The acquisition time is therefore given by the expression

$$T_{acq} = (\tfrac{1}{2}\ Q - 1)T_o + T_1.$$

Substituting and rearranging, one arrives at the expression

$$T_{acq} = \frac{1}{P_d}[(1+\alpha K)(Q-1-1/2QP_d)(1+K)]T$$

Hence, given the signal-to-noise ratio (SNR), the required detection probability, P_d, the false alarm probability, α, and a cost factor, one can compute the necessary integration time, T. Then, given T and the uncertainty, Q, the mean acquisition time, T_{acq}, can be determined.

For a particular value of E_s/N_o at the input filter, the input signal-to-noise ratio is given by

$$SNR_c = \frac{S}{N_c} = \frac{2}{T_s\ W_c}\ \frac{E_s}{N_o}$$

Assuming that the signal is AGC controlled at the output of the SU receiver filter 15, then $S + N_c = 1$, from which it follows that

$$S = \frac{SNR_c}{1 + SNR_c} \quad and \quad N_c = \frac{1}{1 + SNR_c},$$

where S is the signal power, and N_c the noise power at the

output of W_c. In addition, $N_o = 2N_c/W_c$. The noise power at the output of the detector filter 17, W_s, is then $N_s = N_oW_s/2$, from which the signal-to-noise ratio in the energy detector 19a or 19b can be calculated as $SNR_s = S/N_s$. The probability distribution functions for each hypothesis are then completely determined by the parameters:

$$\sigma_0^2 = \sigma_1^2 = N_s \text{ and } \lambda = nS.$$

The foregoing analysis is now generalized to a multi-user channel of most interest to this invention. By example, there may be M≤30 active users (SUs 14) in the CDMA communication system 10, each of which receives coded information symbols from the RBU 12, with an assigned length P = 32 code. All of the pn codes are mutually orthogonal when aligned, and are assumed to be accurately aligned during normal operation. The symbol rate for each SU 14 is fixed at $1/T_s$, and the chipping rate at $1/T_c = P/T_s$. The RBU 12 transmits all active channels together synchronously and uniformly, and hence the channel power levels and timing offsets received at any one SU 14 are substantially equal.

In addition to the user channels, there are two additional channels which all SUs 14 make use of. One, which is never active, is referred to as the above-described null-channel. Although the null-channel is assigned a unique pn code (referred to herein as the null-code), which is orthogonal to every active code, the null-code is not actually transmitted. That is, the null-code can be considered as a "missing" code. This is schematically shown in Fig. 1 by the open switch (SW) placed in the NULL signal path. The switch (SW) could also be placed in the pn_null path, such that the pn code assigned to the null channel (pn_null) does not reach the associated multiplier (spreader) 12c.

The second channel, referred to above as the side-channel, is always active. The side channel provides side-information to the SUs 14 (e.g., system access information, etc.). The side-channel is used as well for code-synchronization, as described below.

In a single-user acquisition technique or test (SUT), only a side-channel statistic is employed, while in a multi-user acquisition technique or test (MUT), the null-channel statistic is employed. It is also within the scope of this invention to employ two different statistics; one corresponding to the null-channel and the other to the side-channel, as explained below.

Single-user technique: For this measurement, the side-channel pn code is used as the SU 14 correlation code, c(t - m∂t), as shown in the non-coherent square law detector block diagram of Fig. 2 and also the non-coherent absolute value detector block diagram of Fig. 3. The single-user technique makes use of this statistic alone in an attempt to locate a correlation peak between the copy of the side-channel pn code stored in the SU 14 and the active side-channel itself. The maximum point on this peak occurs when the codes are aligned.

The multi-user technique: For this measurement, the null-code is used as the correlation code. The multi-user test makes use of this statistic alone in an attempt to find a correlation null (as opposed to peak) between the copy of the null-code stored in the SU 14 and the active channels. The correlation null results from the mutual orthogonality of every possible active code with the null-code, and coincides with code alignment.

It has been found that the single-user test may be reduced in effectiveness when M approaches the maximum number of allowed active users. This is due to the fact that the

multi-user interference level drops just as the side-channel correlation signal rises, in a nearly self-canceling fashion. Similarly, when M is small, it has been found that the multi-user test may be reduced in effectiveness, because the correlation null can be masked by ambient noise.

In order to compensate for these effects, it is preferred to use a difference between these two statistics when acquiring the FL. Hence, for large M, the single-user statistic dominates, and for small M, the multi-user statistic dominates. But, in either case, the difference between the two statistics changes significantly (i.e., becomes larger) as the pn code timing approaches the lock point. This advantage is mitigated somewhat by the doubling of an observation window, $T = 2nT_s$. However, and referring now to Fig. 4, it can be readily seen that the use of the difference test provides an overall advantage in mean acquisition time when compared over the full range of possible numbers of active users.

The detection in accordance with this invention is thus preferably performed on two probability distribution functions (pdf) resulting from the difference between the two statistics described above. As in the single-user detection case, one pdf corresponds to a H_o case, or codes mis-aligned case, the other to a H_1 case, or codes aligned case. In either case, and because the two statistics are computed sequentially, the noise components are essentially uncorrelated. The pn codes are length P=32, and the timing is searched in the SU 14 in half-chip increments ($\delta t = T_c/2$), thus giving Q = 64 possible positions. The time cell yielding the best signal level will therefore, at worst, be off by $1/4T_c$.

Given the H_o case, both the single-user and multi-user tests yield ambient gaussian white noise and multi-user

interference. Since the multi-user codes are uncorrelated with the test code, both noise components are assumed gaussian, and hence central a χ^2 distributed at the detector output. The channel noise variance is $N_s = \frac{1}{2}N_oW_s$, where $\frac{1}{2}N_o = N_c/W_c$ is the two-sided noise spectral power density. Hence $N_s = N_cT_c/2T_s = \frac{1}{2}N_c/P$. The worst case multi-user interference power is $I_s = \frac{1}{2}I_oW_s$, where $\frac{1}{2}I_o$ is the two-sided interference spectral density.

It should be noted that the interference density varies over the null-to-null bandwidth of the receiver filter 15 of Figs. 2 and 3. Of most interest, however, is the density near DC. The equivalent interference bandwidth at this power density is $\frac{1}{2}W_c = 1/T_c$. Hence, $\frac{1}{2}I_o = I_cT_c$, and $I_s = I_cT_c/T_s = I_c/P$. For the H_o hypothesis, then $\sigma_0^2 = I_s + N_s + S/P = \frac{1}{p}\left[1-\frac{1}{2}N_c\right]$, where S/P represents the contribution of the side-channel.

Given the H_1 case, the single-user test yields the ambient white gaussian noise term and a deterministic signal component, and hence contributes a non-central χ^2 distributed random variable at the output of the detector 12d. The multi-user test yields ambient white gaussian noise which contributes a central χ^2 distributed random variable. This assumes, of course, that the multi-user interference can be ignored due to the mutual orthogonality of the aligned pn spreading codes. However, and because of filtering, the pn codes are typically not strictly orthogonal. It can be shown that, with 3-pole butterworth filtering, the interference null depth is approximately 25 dB upon pn code alignment. Thus, for worst case fades ($E_s/N_o \approx 3$ dB), the interference null can be well below the ambient white gaussian noise level. Another factor to consider results from the fact that the worst case alignment offset of $\frac{1}{4}T_c$ will have the effect of weakening

the interference null and the signal correlation peak. From the graphs shown in Fig. 5, the multi-user correlation null can be seen to lose as much 14 dB and the single-user correlation peak about 2 dB. Thus, these effects are taken into consideration. It can be assumed however, that for a worst case fade, the noise variance is approximately $\sigma_1^2 = N_s$ for both the single-user and multi-user statistics. The non-centrality parameter λ is equal to nS.

The probability distribution function for a random variable which is the difference between two other independent random variables, Z = X - Y, can be determined from the integral:

$$fz(z) = \int_{-\infty}^{+\infty} fx(x)\, fy(x-z)\, dx,$$

which is similar to a convolution integral. The H_o and H_1 distributions can thus be obtained by direct integration, or from the inverse fourier transform of the product of modified forms of the characteristic functions for the central and non-central χ^2 distributions.

For the multi-user acquisition case, the SU 14 automatic gain control (AGC) function is assumed set such that $S + N_c + I_c = 1$, where $I_c = MS$ is the multi-user interference power. Hence, $(M + 1)S + N_c = 1$. As is also the case for the single-user approach, the SNR can be defined as:

$$SNR_c = \frac{S}{N_c} = \frac{2}{T_s W_c} \frac{E_c}{N_o} = \frac{1}{P} \frac{E_s}{N_o},$$

It thus follows that:

$$N_c=\frac{1}{(M+1)\,SNR_c+1},\ S=\frac{SNR_c}{(M+1)\,SNR_c+1},\ \text{and}\ I_c=\frac{MSNR_c}{(M+1)\,SNR_c+1}$$

Upon setting $\lambda = nS$, the probability distributions are completely determined up to the number of degrees of freedom, which is adjusted to meet the probability of detection and false alarm criteria:

$$P_d=\int_{t_h}^{\infty} Pz_1(z)\,dz \text{ and } a=\int_{T_h}^{\infty} Pz_o(z)\,dz$$

for some threshold t_h.

Based on the foregoing, and in accordance with a first aspect of this invention, there is provided a method for the SU 14 to acquire the correct code timing for a synchronous CDMA forward channel link in the presence of some amount of multi-user interference (MUI). This method exploits the orthogonality of the pn codes used to determine the proper code phase by purposely despreading a pn code (i.e., the null code) which is known to not be present. This is done to overcome the problem that arises when using a conventional acquisition procedure when many users are active. In this case the interference energy of P-1 interfering users, with processing gain P, can be nearly as strong as the energy of the desired user's signal. As a result, the standard acquisition approach, wherein a detection is declared when the energy of a matched filter output (or sliding correlator output) is larger than a threshold, is not viable in a heavily loaded system.

To simplify the discussion of the method, it is assumed that the frequency offset between the carrier of the incoming signal and the receiver's local oscillator is

zero.

Fig. 6 illustrates the energy of the matched filter output due to the desired user's signal, due to the interfering users, and due to the background noise as a function of the timing offset of the matched filter. It should be noted that on the forward channel, the user signals are all assumed to perfectly synchronized with each other. The different curves shown in Fig. 1 represent the various components of the received signal, and the sum of these components make up the received strength. It is important to note that the MUI energy due to a receiver chip timing offset is comparable to the energy of the desired user's signal when the receiver is not offset. The implication of this is that a standard acquisition algorithm would not be able to easily distinguish the difference between the offset and synchronized phases. In fact, unless additional averaging takes place, the signal energy is essentially equal to the noise variance, which implies a detection signal-to-noise ratio (SNR) of approximately 0 dB.

It should also be noted that the noise due to MUI and the noise due to background noise are both zero mean noise processes. In the conventional detection procedure, the absolute value of the larger of I and Q despreader outputs are taken and the results are averaged over some dwell time. The fact that the noise has a zero mean implies that it is possible to increase the decision SNR by averaging the detection statistics. However, in the case of a heavily loaded system, the averaging time would be required to be long in order to create a large enough SNR to determine reliably whether the receiver is correctly synchronized to a signal.

In contrast with the standard acquisition approach, and in accordance with an aspect of this invention, if the SU receiver instead despreads a PN code which is not

transmitted, then the noise will be "tuned out" when the receiver comes into alignment with the interfering signals. This implies that the SU receiver can look for the "hole in the noise" which occurs at the zero offset phase, and thus determine when the noise energy at a sliding correlator output drops below a threshold. At this time the acquisition circuit can declare that a lock has occurred. This technique has been referred to above as the multi-user test (MUT).

Although this approach provides significant advantages over the conventional acquisition technique, two problems can arise during the use of the MUT approach.

The first problem results from the fact that the number of interfering users is not constant, and so the absolute level of the MUI is not fixed. This complicates the acquisition problem because in the lightly loaded case, where the background noise is non-negligible, the noise power may not decrease at the output of the matched filter when the code alignment becomes perfect.

The second problem results from the fact that the threshold of noise power at which a lock should be declared is a function of the number of currently active interfering users, and so some type of calibration procedure should be performed to set this threshold. Such a calibration procedure may involve scanning the possible code phases in half-chip steps to determine an average energy level and the lowest energy level. If the lowest energy level is found to be lower than the average level by more than some threshold amount, then the lowest energy level phase may be declared to be the lock phase. The penalty associated with this approach, however, is that the calibration procedure can require a substantial amount of time to perform, namely 2P times the dwell time. While a lengthy acquisition time for the SU is not a serious drawback, since it only occurs

at startup and after long deep fades, it would be preferable to avoid a relatively long mean time to acquisition if possible.

Figs. 7A-7D illustrate four possible situations of loading (number (N) of active interfering users) and background noise levels. In each case, the matched filter or sliding correlator output is shown, when matched to the side-channel pn code and to the null pn code (i.e., the pn code that is not transmitted). It is clear that the behavior of the null pn code and side-channel pn code sliding correlators varies by a large amount depending on the channel loading and background noise level.

In a presently preferred embodiment of this invention both the signal user test (SUT) and the multi-user test (MUT) are performed, and the results are subtracted at each phase state. The procedure for this presently preferred technique is shown in the logic flow diagram of Fig. 8.

In this procedure, at each of the 2P phase states (for example 64 phase states), and beginning with a phase x (Block A), the SU receiver first performs the signal user test (SUT) by averaging the absolute value of some number of the larger of the I and Q despreader outputs (Block B). The SU receiver then performs the multi-user test (MUT) at Block C by doing the same averaging with the despreader employing the null pn code. The difference of these two test statistics is then computed (Block D) and if the difference, Z(x), is larger than a threshold, a detection is declared (Block E). If the threshold is not exceeded, the SU processor 12e stores Z(x) in an associated memory (MEM). At Block F a determination is made by the processor 12e if all 64 possible phase states of phase x have been checked. If no, control passes to Block G where the processor 12e slips the receiver's chip-clock to the next phase state, and the loop is re-entered at Block B.

If all 64 possible phase states are exhausted and no detection is declared at Block F, then there at least two options. The first option is that the SU processor 12e can sort the stored Z(x) values and pick the phase state, x, with the largest Z(x) value (Block H). The second option is that the receiver can continue slipping the x value through the 64 possible states again in the event that a temporary fade was responsible for the missed detection on the first pass.

This method of using the relative differences of the two tests (SUT and MUT), rather than an absolute test result, provides a test which is more robust, as well as a test which yields a lower mean time to acquisition than the use of an absolute test.

The overall purpose of the method is to provide a multi-user acquisition procedure for use by the SU 14 in acquiring the forward side-channel in the presence of many interfering forward channel signals. An important aspect of this method is that by comparing the result of the single user test (SUT) to that of the multi-user test (MUT), for each possible phase state, the relative difference between the two tests is better able to distinguish the correct phase state from all of the incorrect phase states.

The presently preferred embodiment of this invention assumes that no timing (reference) information is present, and up to, by example, 10 symbol rates of frequency uncertainty exists. It is also assumed that all interfering channels transmit independent random data.

Further in accordance with an aspect of this invention, a single acquisition sequence, also referred to as a "look", includes setting a particular chip code phase and carrier frequency and thereafter accumulating a detected value (i.e., a magnitude of an in-phase (I) component plus a

magnitude of a quadrature (Q) component) of, nominally, 64 symbols. This operation is accomplished by the detector circuitry 12d, and the resulting value is supplied to the processor 12e which controls the overall acquisition sequence. By example, at 17 Kbaud this operation can occur every 3.8 milliseconds.

The acquisition technique in accordance with this embodiment of the invention is comprised of four components; referred to herein as channel evaluation, code phase search, carrier frequency pull-in, and carrier lock.

The channel evaluation component operates to search for a region of orthogonality during periods of heavy use (high communications traffic). A pn spreading code for an unused channel (the null channel) is supplied and a timing search is performed at a nominal carrier frequency in half chip steps. A reduction in a detected signal energy level is assumed to be indicative of the presence of a region of orthogonality, i.e., a pn code that is approximately equal to the proper pn timing. If look values are found below a threshold proportional to a mean look value, timing detection is declared. Longer looks at plus and minus 1/2 chip steps and frequency steps of 1/4 the symbol rate may then be made to more closely determine a lock point. The desired channel's (e.g., the side-channel) pn code is then switched in, and the carrier frequency pull-in is implemented.

If no pn code phase is found to result in the detection of a signal below threshold, the carrier frequency is incremented in, by example, half symbol rate steps and the channel evaluation procedure is repeated. The use of half symbol rate steps assumes that orthogonality is significantly reduced for frequency offsets of 1/4 symbol rate. If the frequency uncertainty is exhausted without locating a region of orthagonality, it is assumed that

insufficient interference sources, or interferers, exist to produce such a region and a conventional code phase search is performed.

The above-described channel evaluation search uses, by example, 256 pn code phases with, by example, 20 frequency increments and takes approximately 20 seconds to complete. The channel evaluation search requires the use of the channel known to be vacant (i.e., the null channel).

The conventional code phase search is performed if the channel evaluation search does not produce a result. The conventional code phase search uses the pn code of the channel to be acquired (e.g., the side-channel). The pn code space is searched in half chip steps for each frequency in 1/2 symbol rate steps, and seeks to locate a look value above a threshold that is proportional to the mean value. A full chip search is performed and a largest look value above threshold is taken as the lock point. As a result, any multipath signal weaker than the direct signal will also be detected. If the conventional code phase search is unsuccessful the channel evaluation search may be tried again.

Once the timing phase is established to within 1/4 chip by one of the two above-described code phase search techniques, and the carrier frequency is tuned to within 1/4 symbol rate, the chip timing loop is closed and a carrier frequency pull-in is accomplished. The frequency pull-in procedure operates to tune the LO frequency (see Fig. 1) to a point where phase lock can be rapidly accomplished without false locking to symbol rate sub-harmonics.

An intra-symbol discriminator may also be employed. The intra-symbol discriminator uses another pn code channel which has a pn code that represents the desired pn code but

with the second half inverted. A channel using that particular code will interfere with the discrimination process, but the interference will a zero mean interference (assuming random data) that is readily filtered by the loop filter. The frequency pull-in procedure terminates after a fixed time at which the SU 14 is switched to phase lock, thereby ending the acquisition procedure. Thereafter the SU 14 continuously performs carrier phase error detection to determine a loss of lock. If a loss of lock is detected the SU 14 returns to the channel evaluation search.

While the invention has thus been particularly shown and described above with respect to a number of embodiments thereof, it will be understood by those skilled in the art that changes in form and details may be made therein without departing from the scope and spirit of the invention.

For example, it should be realized that the teaching of this invention is not limited to any of the exemplary frequencies, pn code lengths, numbers of users, despreader and detector embodiments, and the like that were described above. Furthermore, it should be realized that the threshold in Block D of Fig. 8 can be made variable or adaptive as, by example, a function of the number of times that the method loops through this block. An initial setting of the threshold can be accomplished in accordance with calibration procedure that slips through all phase states, and sets the threshold to lie between the highest and the second highest measured correlation values.

It should further be understood that the teaching of this invention is not limited for use with the RF transmitters and receivers illustrated in Fig. 1. That is, in other embodiments of this invention the CDMA forward and reverse link signals can be conveyed through, by example, coaxial cable or fiber optic cable. The CDMA signal could also be

conveyed through water, using suitable acoustic transducers.

The above described embodiments should thus be viewed as being exemplary of the teaching of this invention, and should not be construed in a limiting sense upon the practice of this invention.

CLAIMS

What is claimed is:

1. A method for synchronizing to a forward channel in a CDMA system, comprising the steps of:

despreading a received CDMA signal with a first pn code that is known not to be present in the received CDMA signal and obtaining a measure of received signal level; and

using the obtained measure of the received signal level when setting a phase of a second pn code that corresponds to a desired forward channel that is to be received.

2. A method as set forth in claim 1, wherein the step of despreading despreads a null channel, and wherein the desired forward channel is a continuously transmitted side-channel.

3. A method as set forth in claim 1, wherein the step of obtaining a measure of received signal level obtains a correlation null.

4. A method as set forth in claim 1, wherein the steps of despreading and obtaining are accomplished iteratively over a range of first pn code phase states.

5. A method for acquiring a forward channel in a point-to-multipoint CDMA system, comprising the steps of:

despreading a received CDMA signal with a first pn code that is known to be present in the received CDMA signal and obtaining a first measure of received signal level;

despreading the received CDMA signal with a second pn code that is known not to be present in the received CDMA signal and obtaining a second measure of received signal level; and

synchronizing to a desired channel using a difference between the first and second signal levels.

6. A method as set forth in claim 5, wherein the first step of despreading despreads a continuously transmitted side-channel, and wherein the step of synchronizing synchronizes to the side-channel.

7. A method as set forth in claim 5, wherein the step of obtaining a first measure of received signal level obtains a correlation peak, wherein the step of obtaining a second measure of received signal level obtains a correlation null.

8. A method as set forth in claim 5, wherein the steps of despreading and obtaining are accomplished iteratively over a range of first pn code phase states and over a range of second pn code phase states.

9. A method as set forth in claim 5, wherein the steps of despreading and obtaining are accomplished iteratively over a plurality n of first pn code phase states and over a plurality n of second pn code phase states, and further comprising the steps of:

for a pn phase state i of the plurality n of first and second pn code states,

determining a difference value between the first measure of received signal level and the second measure of received signal level;

comparing the difference value to a threshold value; and

if the difference value is greater than the threshold value, setting a pn code generator to output a pn code corresponding to the desired channel, the outputted pn code being set at the pn phase state i;

else, if the difference value is not greater than the threshold value, incrementing the pn phase state i and re-executing the steps of despreading and obtaining.

10. A method as set forth in claim 9, wherein if none of the n difference values are greater than the threshold value, further comprising the steps of resetting i to an initial value and re-executing the steps of despreading and obtaining.

11. A method as set forth in claim 10, and further comprising a step of adjusting the threshold value prior to re-executing the steps of despreading and obtaining.

12. A method as set forth in claim 9, wherein the step of determining the difference value includes a step of storing the determined difference value, and if none of the n difference values are greater than the threshold value, further comprising the steps of:

examining the stored difference values to select a stored difference value that has a largest value; and

setting the pn code generator to output the pn code corresponding to the desired channel, the outputted pn code being set to a pn phase state that corresponds to the selected stored difference value.

13. A synchronous CDMA communications system, comprising:

at least one radio base unit (RBU) comprising means for transmitting a plurality of first forward channels, individual ones of said first forward channels being intended for receipt by one subscriber, and for transmitting at least one second forward channel that is intended for receipt by a plurality of subscribers, each of said forward channels being spread with an associated pn code that has an orthogonal relationship to associated pn codes of the other forward channels; and

a plurality of subscriber units (SUs) individual ones of which comprise means for receiving the plurality of first forward channels and the at least one second forward channel, individual ones of said SUs further comprising means for despreading the at least one second forward channel, using a first pn code associated with the second forward channel, and for obtaining a first measure of received signal level; individual ones of said SUs further comprising means for despreading the received forward channels using a second, null pn code that is not transmitted by the RBU and for obtaining a second measure of received signal level, said null pn code having an orthogonal relationship to the transmitted pn codes; and further comprising means for setting a phase of the first pn code associated with the second forward channel using a difference between the first and second measures of signal level.

14. A CDMA communications system as set forth in claim 13, wherein said means for obtaining a first measure of received signal level obtains a correlation peak, and wherein said means for obtaining a second measure of

received signal level obtains a correlation null.

15. A CDMA communications system as set forth in claim 13, wherein said means for despreading and obtaining operate iteratively over a range of first pn code phase states and over a range of second pn code phase states.

A MULTI-USER ACQUISITION PROCEDURE FOR POINT-TO-MULTIPOINT SYNCHRONOUS CDMA SYSTEMS

ABSTRACT OF THE DISCLOSURE

Disclosed are methods for acquiring a forward channel in a point-to-multipoint CDMA system. One method includes the steps of (a) despreading a received CDMA signal with a first pn code that is known to be present in the received CDMA signal and obtaining a first measure of received signal level; (b) despreading the received CDMA signal with a second pn code that is known not to be present in the received CDMA signal and obtaining a second measure of received signal level; and (c) synchronizing to a desired channel using a difference between the first and second signal levels. In this method the first step of despreading despreads a continuously transmitted side-channel, and the step of synchronizing synchronizes to the side-channel. Also, the step of obtaining a first measure of received signal level obtains a correlation peak, and the step of obtaining a second measure of received signal level obtains a correlation null. Preferably, the steps of despreading and obtaining are accomplished iteratively over a range of n first pn code phase states and over a range of n second pn code phase states.

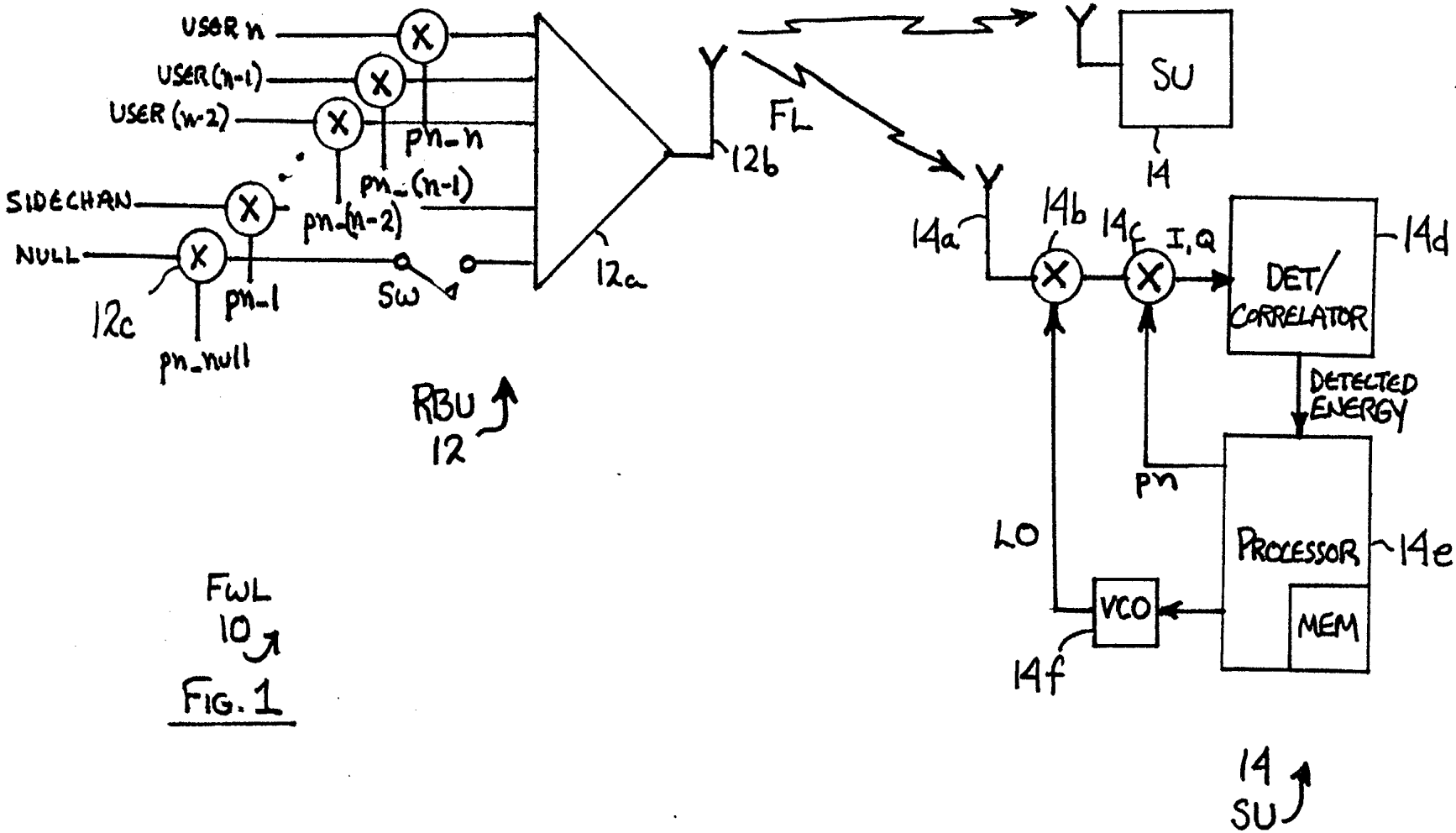

USER n
USER (n-1)
USER (n-2)
SIDECHAN
NULL
pn_n
pn_(n-1)
pn_(n-2)
pn_1
pn_null
12c
Sw
12a
12b
FL
SU
14
14a
14b
14c
I,Q
DET/ CORRELATOR
14d
DETECTED ENERGY
pn
LO
PROCESSOR
14e
VCO
MEM
14f
RBU 12
14 SU
FWL 10

FIG. 1

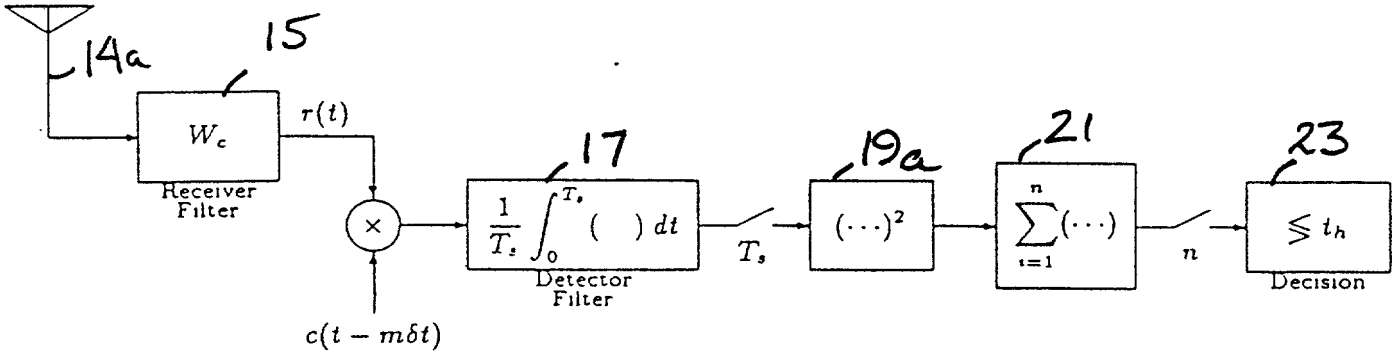

14a
15
W_c
Receiver Filter
$r(t)$
$c(t - m\delta t)$
17
$\frac{1}{T_s}\int_0^{T_s}(\ )\,dt$
Detector Filter
T_s
19a
$(\cdots)^2$
21
$\sum_{i=1}^{n}(\cdots)$
n
23
$\lessgtr t_h$
Decision

FIG. 2

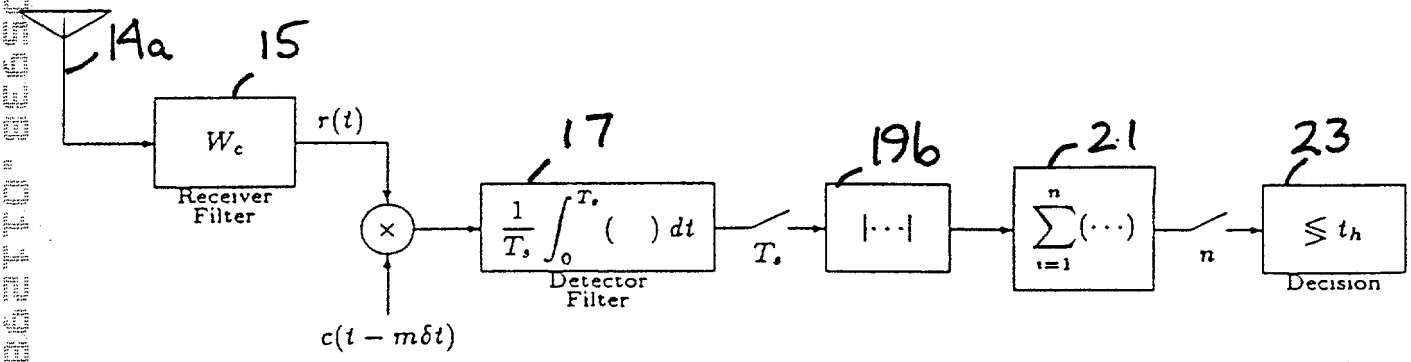

14a
15
W_c
Receiver Filter
$r(t)$
$c(t - m\delta t)$
17
$\frac{1}{T_s}\int_0^{T_s}(\ )\,dt$
Detector Filter
T_s
19b
$|\cdots|$
21
$\sum_{i=1}^{n}(\cdots)$
n
23
$\lessgtr t_h$
Decision

FIG. 3

FIG. 4

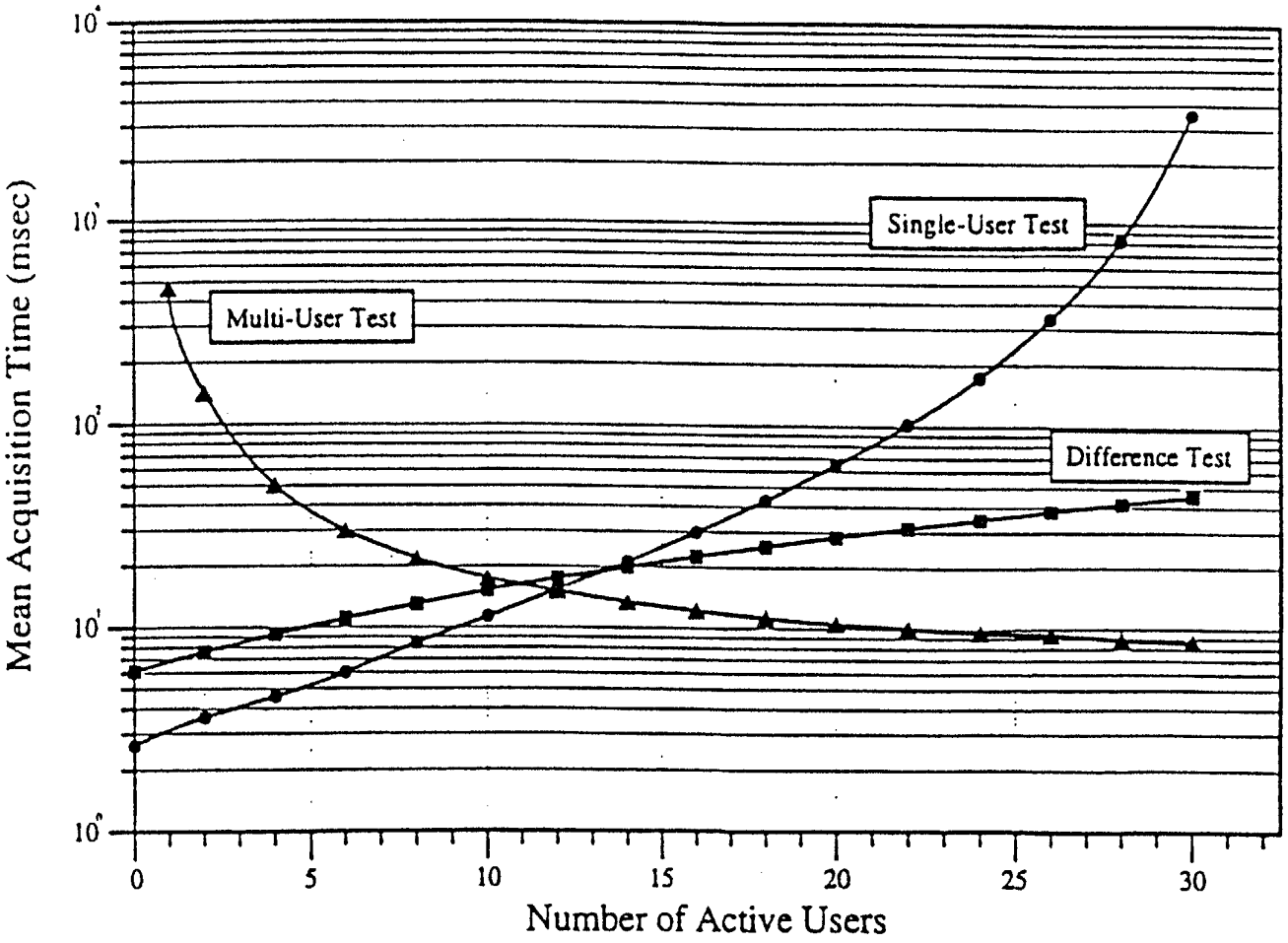


FIG.5

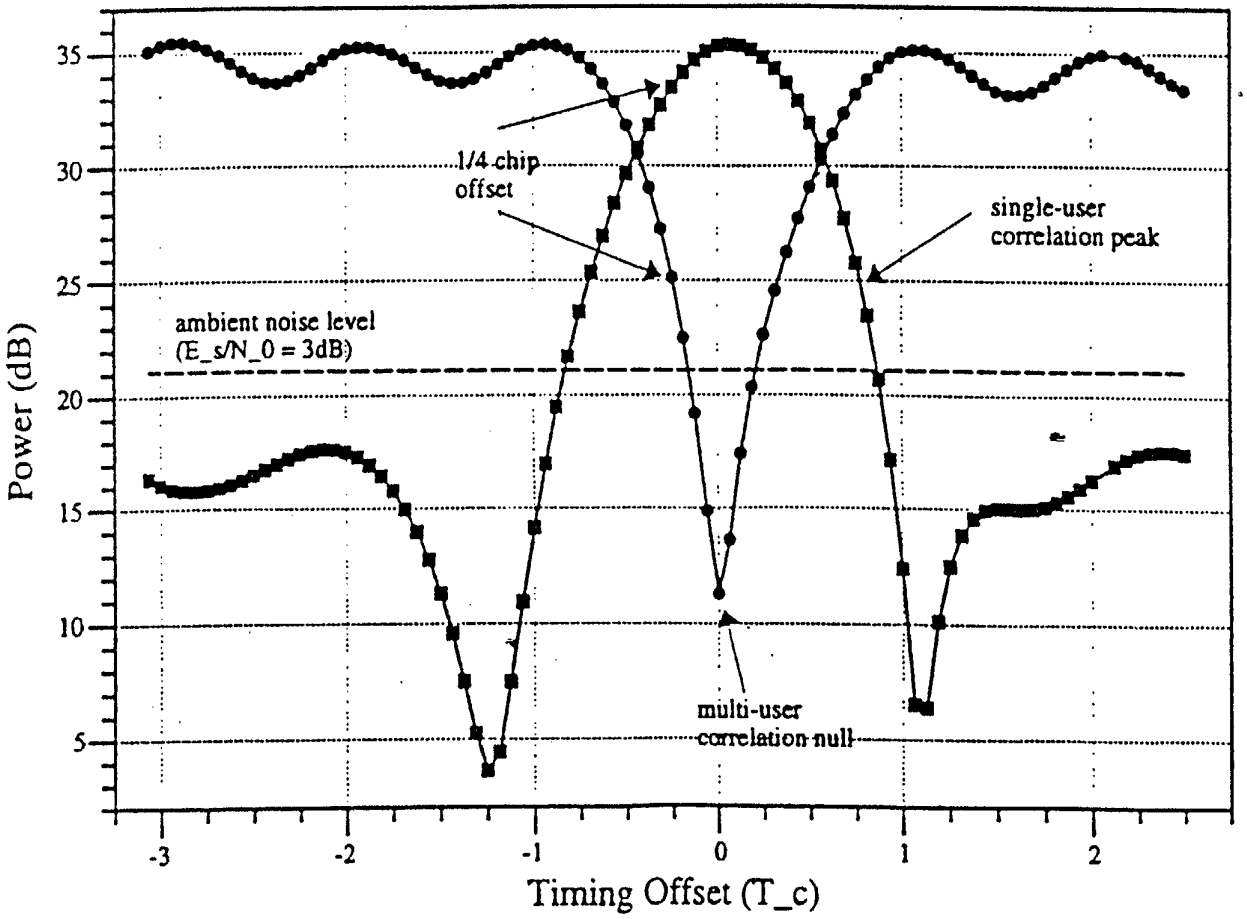
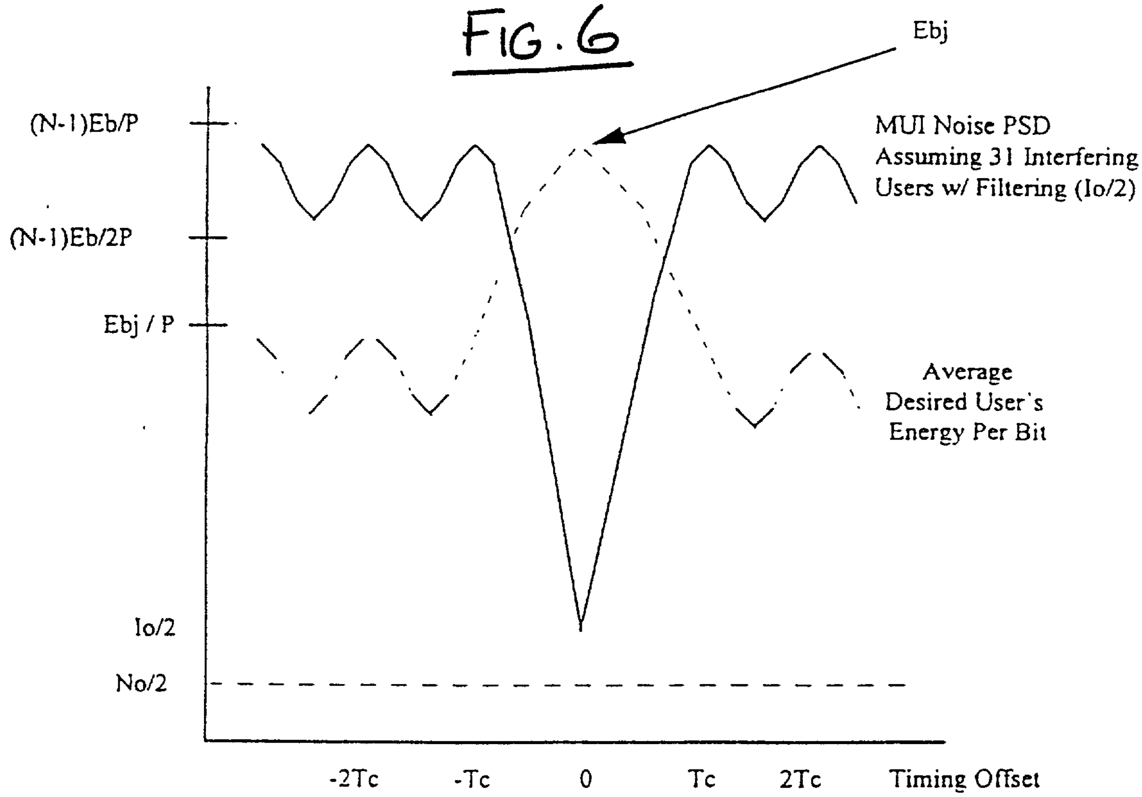

35
30
25
20
15
10
5
Power (dB)
1/4 chip offset
single-user correlation peak
ambient noise level (E_s/N_0 = 3dB)
multi-user correlation null
-3
-2
-1
0
1
2
Timing Offset (T_c)

FIG. 6



Light Loading (N=2)

Heavy Loading (N=32)

High SNR

FIG. 7A

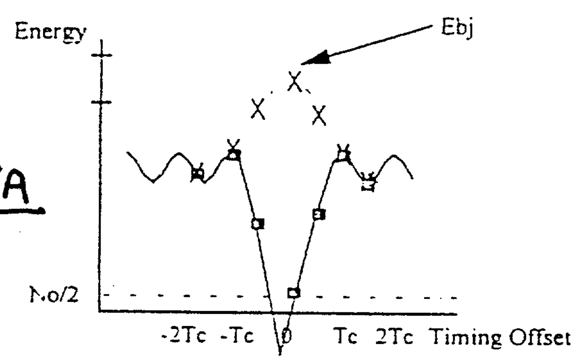
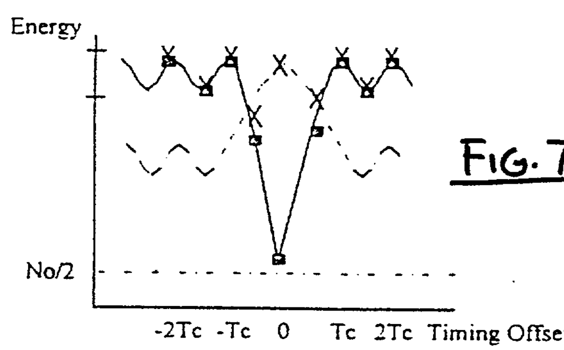


FIG. 7B



Low SNR

FIG. 7C

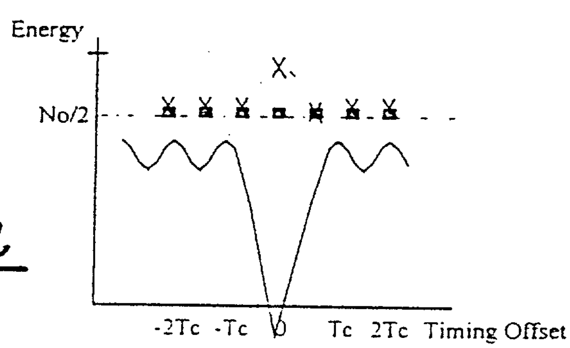
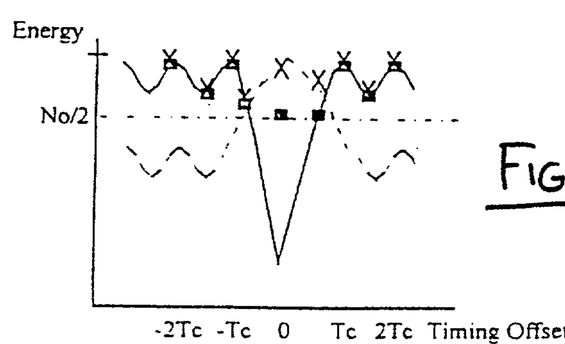


FIG. 7D



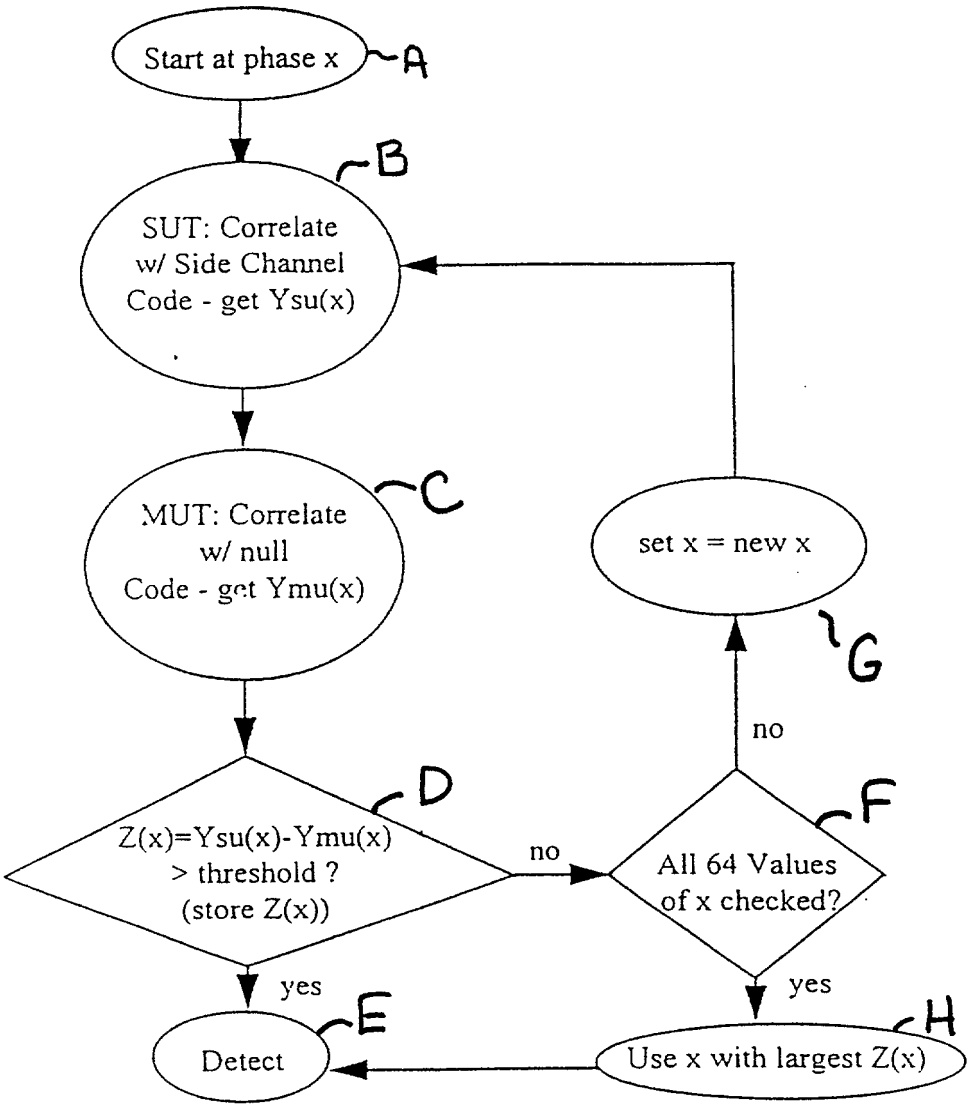

Start at phase x
A
B
SUT: Correlate w/ Side Channel Code - get Ysu(x)
C
MUT: Correlate w/ null Code - get Ymu(x)
D
Z(x)=Ysu(x)-Ymu(x) > threshold ? (store Z(x))
no
yes
E
Detect
F
All 64 Values of x checked?
no
yes
G
set x = new x
H
Use x with largest Z(x)

FIG. 8

COMBINED DECLARATION AND POWER OF ATTORNEY

(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL, CONTINUATION OR C-I-P)

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type:

(check one applicable item below)

- ☒ original.
- ☐ design.
- ☐ supplemental.

NOTE: If the declaration is for an International Application being filed as a divisional, continuation or continuation-in-part application, do not check next item; check appropriate one of last three items.

- ☐ national stage of PCT.

NOTE: If one of the following 3 items apply, then complete and also attach ADDED PAGES FOR DIVISIONAL, CONTINUATION OR C-I-P.

- ☐ divisional.
- ☐ continuation.
- ☐ continuation-in-part (C-I-P).

INVENTORSHIP IDENTIFICATION

WARNING: *If the inventors are each not the inventors of all the claims, an explanation of the facts, including the ownership of all the claims at the time the last claimed invention was made, should be submitted.*

My residence, post office address and citizenship are as stated below, next to my name. I believe that I am the original, first and sole inventor *(if only one name is listed below)* or an original, first and joint inventor *(if plural names are listed below)* of the subject matter that is claimed, and for which a patent is sought on the invention entitled:

TITLE OF INVENTION

A MULTI-USER ACQUISITION PROCEDURE FOR POINT-TO-MULTIPOINT SYNCHRONOUS CDMA SYSTEMS

SPECIFICATION IDENTIFICATION

the specification of which:

(complete (a), (b) or (c))

(a) ☐ is attached hereto.

(b) ☒ was filed on 2/23/96, as ☒ Serial No. 08/606,378 or ☐ Express Mail No., as Serial No. not yet known _____ and was amended on _____ *(if applicable)*.

NOTE: Amendments filed after the original papers are deposited with the PTO that contain new matter are not accorded a filing date by being referred to in the declaration. Accordingly, the amendments involved are those filed with the application papers or, in the case of a supplemental declaration, are those amendments claiming matter not encompassed in the original statement of invention or claims. See 37 CFR 1.67.

(c) ☐ was described and claimed in PCT International Application No. _____, filed on _____ and as amended under PCT Article 19 on _____ *(if any)*.

ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information, which is material to patentability as defined in 37, Code of Federal Regulations, § 1.56,

(also check the following items, if desired)

☒ and which is material to the examination of this application, namely, information where there is a substantial likelihood that a reasonable Examiner would consider it important in deciding whether to allow the application to issue as a patent, and

☐ in compliance with this duty, there is attached an information disclosure statement, in accordance with 37 CFR 1.98.

PRIORITY CLAIM (35 U.S.C. § 119(a)-(d))

I hereby claim foreign priority benefits under Title 35, United States Code, § 119(a)-(d) of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

(complete (d) or (e))

(d) ☒ no such applications have been filed.

(e) ☐ such applications have been filed as follows.

NOTE: Where item (c) is entered above and the International Application which designated the U.S. itself claimed priority check item (e), enter the details below and make the priority claim.

PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS APPLICATION AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119(a)-(d)

COUNTRY (OR INDICATE IF PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 USC 119
			☐ YES NO ☐
			☐ YES NO ☐
			☐ YES NO ☐
			☐ YES NO ☐
			☐ YES NO ☐

CLAIM FOR BENEFIT OF PRIOR U.S. PROVISIONAL APPLICATION(S)

(34 U.S.C. § 119(e))

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

PROVISIONAL APPLICATION NUMBER	FILING DATE
_____ /_____	_____
_____ /_____	_____
_____ /_____	_____

CLAIM FOR BENEFIT OF EARLIER US/PCT APPLICATION(S) UNDER 35 U.S.C. 120

☐ The claim for the benefit of any such applications are set forth in the attached ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR CONTINUATION-IN PART (C-I-P) APPLICATION.

ALL FOREIGN APPLICATION(S), *IF ANY*, FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

NOTE: If the application filed more than 12 months from the filing date of this application is a PCT filing forming the basis for this application entering the United States as (1) the national stage, or (2) a continuation, divisional, or continuation-in-part, then also complete ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR C-I-P APPLICATION for benefit of the prior U.S. or PCT application(s) under 35 U.S.C. § 120.

POWER OF ATTORNEY

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

(list name and registration number)

Clarence A. Green, Esq. (24,622)
Harry F. Smith, Esq. (32,493)

(check the following item, if applicable)

☐ Attached, as part of this declaration and power of attorney, is the authorization of the above-named attorney(s) to accept and follow instructions from my representative(s).

SEND CORRESPONDENCE TO

Harry F. Smith, Esq.
Perman & Green
425 Post Road
Fairfield, CT 06430

DIRECT TELEPHONE CALLS TO:
(Name and telephone number)

Harry F. Smith
(203) 259-1800

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

SIGNATURE(S)

NOTE: Carefully indicate the family (or last) name, as it should appear on the filing receipt and all other documents.

Full name of sole or first inventor

Samuel	C	Kingston
(GIVEN NAME)	(MIDDLE INITIAL OR NAME)	FAMILY (OR LAST NAME)

Inventor's signature Samuel C Kingston

Date 6/11/96 Country of Citizenship USA

Residence 87 West 300 North, Salt Lake City, UT 84104

Post Office Address 87 West 300 North, Salt Lake City, UT 84104

Full name of second joint inventor, if any

Thomas	R.	Giallorenzi
(GIVEN NAME)	(MIDDLE INITIAL OR NAME)	FAMILY (OR LAST NAME)

Inventor's signature Thomas R Giallorenzi

Date 6/11/96 Country of Citizenship USA

Residence 5214 Cobble Creek Road - Apt. 8F, Salt Lake City, UT 84117

Post Office Address 5214 Cobble Creek Road - Apt. 8F, Salt Lake City, UT 84117

Full name of third joint inventor, if any

Randal	R	Sylvester
(GIVEN NAME)	(MIDDLE INITIAL OR NAME)	FAMILY (OR LAST NAME)

Inventor's signature Randal R Sylvester

Date 6/11/96 Country of Citizenship USA

Residence 3941 South 6165 West, West Valley City, UT 84120

Post Office Address 3941 South 6165 West, West Valley City, UT 84120

SIGNATURE(S)

NOTE: Carefully indicate the family (or last) name, as it should appear on the filing receipt and all other documents.

Full name of : inventor

(GIVEN NAME)	(MIDDLE INITIAL OR NAME)	FAMILY (OR LAST NAME)
David	W	Matolak

Inventor's signature ____________________

Date ____________ Country of Citizenship USA

Residence 1761 East Laird Avenue, Salt Lake City, UT 84108

Post Office Address 1761 East Laird Avenue, Salt Lake City, UT 84108

Full name of joint inventor, if any

(GIVEN NAME)	(MIDDLE INITIAL OR NAME)	FAMILY (OR LAST NAME)
Patrick	J	Smith

Inventor's signature Patrick J Smith

Date 6/11/96 Country of Citizenship USA

Residence 1155 South Lake Street, Salt Lake City, UT 84105

Post Office Address 1155 South Lake Street, Salt Lake City, UT 84105

Full name of joint inventor, if any

(GIVEN NAME)	(MIDDLE INITIAL OR NAME)	FAMILY (OR LAST NAME)

Inventor's signature ____________________

Date ____________ Country of Citizenship ____________

Residence ____________________

Post Office Address ____________________

(check proper box(es) for any of the following added page(s) that form a part of this declaration)

☐ **Signature** for fourth and subsequent joint inventors. *Number of pages added* _____

• • •

☐ **Signature** by administrator(trix), executor(trix) or legal representative for deceased or incapacitated inventor. *Number of pages added* _____

• • •

☐ **Signature** for inventor who refuses to sign or cannot be reached by person authorized under 37 CFR 1.47. *Number of pages added* _____

• • •

☐ Added page for **signature** by one joint inventor on behalf of deceased inventor(s) where legal representative cannot be appointed in time. (37 CFR 1.47)

• • •

☐ Added pages to combined declaration and power of attorney for divisional, continuation, or continuation-in-part (C-I-P) application.

☐ Number of pages added _____

• • •

☐ Authorization of attorney(s) to accept and follow instructions from representative.

• • •

(if no further pages form a part of this Declaration, then end this Declaration with this page and check the following item)

☒ This declaration ends with this page.

Attorney's Docket No. 528-006231-US (C01) **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: S. Kingston et al.
Serial No.: 0 8 / Group No.: 2603
Filed: herewith Examiner: Bnimoussa, A.
For: Multi-User Acquisition Procedure For Point-To-Multipoint Synchronous CDMA Systems

Commissioner of Patents and Trademarks
Washington, D. C. 20231

TRANSMITTAL OF FORMAL DRAWING(S) PRIOR TO NOTICE OF ALLOWANCE

Attached please find the formal drawings for this application.

SIGNATURE OF ATTORNEY

Reg. No. 32,493

Harry F. Smith.
(type or print name of attorney)

Tel. No.: (203) 259-1800

Perman & Green, LLP
(P.O. Address)

425 Post Road, Fairfield, CT 06430

NOTE: "Identifying indicia, if provided, should include the application number or the title of the invention, inventor's name, docket number (if any), and the name and telephone number of a person to call if the Office is unable to match the drawings to the proper application. This information should be placed on the back of each sheet of drawing a minimum distance of 1.5 cm. (5/8 inch) down from the top of the page." 37 C.F.R. 1.84(c)).

CERTIFICATE OF MAILING (37 CFR 1.8(a))

I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to the: Commissioner of Patents and Trademarks, Washington, D.C. 20231.

(type or print name of person mailing paper)

Date: _____

(Signature of person mailing paper)

WARNING: *"Facsimile transmissions are not permitted and if submitted will not be accorded a date of receipt" for "(4) Drawings submitted under §§ 1.81, 1.83 through 1.85, 1.152, 1.165, 1.174, 1.437 . . . ." 37 CFR 1.6(d)(4).*

Transmittal of Formal Drawings [5-2])